

## Ultrasonic Distance Sensor – PWM Out

Ultrasonic Distance Sensor provides range from very short (2 Centimeters) to long-range (5 Meters) for applications in detection and ranging. The sensor provides precise and stable non-contact distance measurements from about 2 cm to 5 meters with very high accuracy.

The ultrasonic sensor can easily be interfaced to microcontrollers where the triggering and measurement can be done using two I/O pin. The sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated.

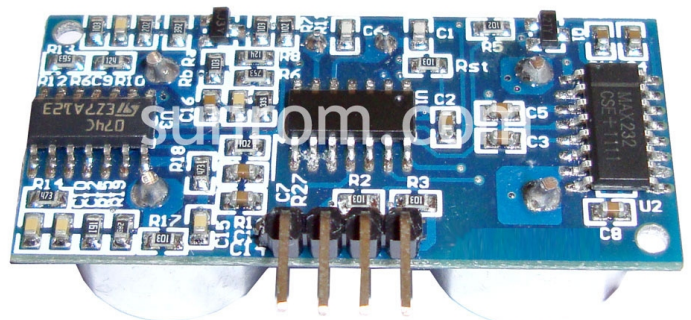
This UltraSonic Distance Sensor is perfect for any number of applications that require you to perform measurements between moving or stationary objects.

## Specifications

- Power supply :5V DC
- Quiescent current : <2mA
- Effectual angle: <15°
- Ranging distance : 2cm – 500 cm
- Resolution : 0.3 cm

## Features

- Accurate and Stable range data
- Data loss in Error zone eliminated
- Modulation at 40 KHz
- Triggered externally by supplying a pulse to the TRIG pin
- 5V DC Supply voltage and Current - <20mA
- Can communicate with 5 V TTL or 3.3V CMOS microcontrollers
- Echo pulse: positive TTL pulse, 87  $\mu$ s minimum to 30 ms maximum (PWM)



## Pinout

There are 4 pins out of the module : VCC , Trig, Echo, GND .

So it's a very easy interface for controller to use it ranging.

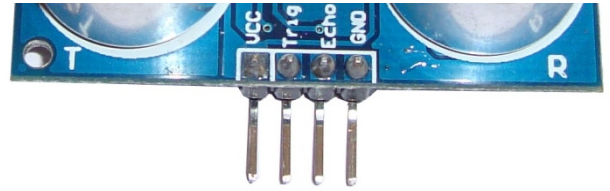
Method of programming will be :

Make the Trig pin to high level for more than 10us pulse and make it low again, so the module start ranging and outputs echo pulse when it finish ranging.

Measure the high duration of echo pulse output.

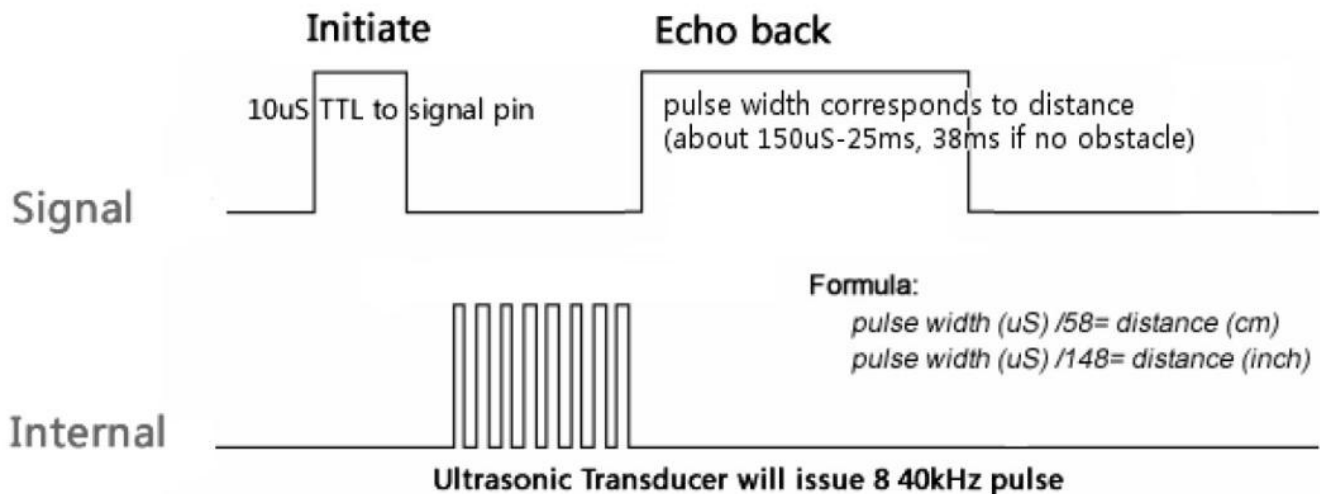
Distance in cm(centimeter) = (Pulse Duration in microsecond)/58

Distance in in(inches) = (Pulse Duration in microsecond)/148



Pin Name	Name	Type	Details
VCC	+5V DC Input supply	Power In	Provide regulated +5V DC supply
TRIG	Trigger Input	Input	10 microsecond trigger pulse input. Your external microcontroller will usually make this pin HIGH then delay for about 10 microsecond and make pin LOW again
ECHO	Echo Output	Output	Output pulse with width depending upon distance in front. After the trigger is given with your microcontroller it measures pulse output on ECHO pin. The measured echo pulse duration is converted to distance
GND	Ground	Ground	Ground of power and should be common ground to external microcontroller

## Sequence Chart

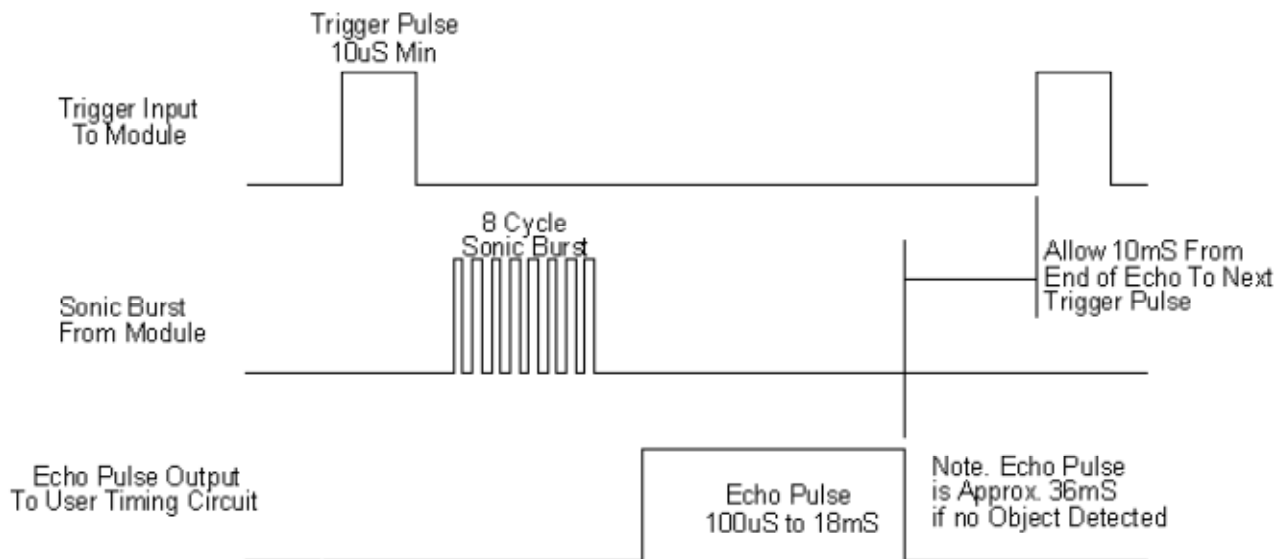


- 1) A short ultrasonic pulse is transmitted at the time of 10uS trigger input pulse
- 2) The pulse is reflected by an object.
- 3) The sensor receives this signal and converts it to an electric pulse of variable duration.

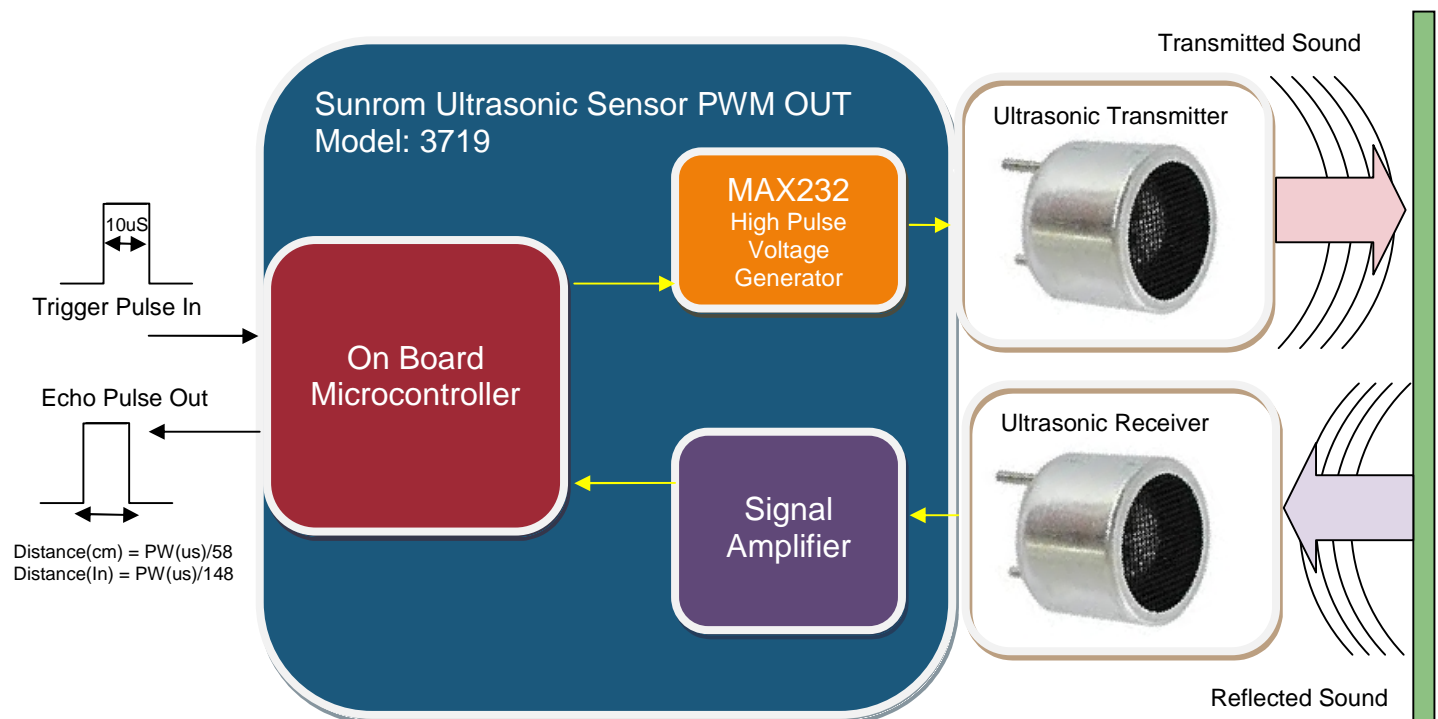
The next pulse can be transmitted when the echo is faded away. This time period is called cycle period. The recommend cycle period should be no less than 50ms. If a 10μs width trigger pulse is sent to the signal pin, the Ultrasonic module will output eight 40kHz ultrasonic signal and detect the echo back. The measured distance is proportional to the echo pulse width and can be calculated by the formula above. If no obstacle is detected, the output pin will give a 38ms high level signal.

## Timing Diagram

The sensor requires a short trigger pulse from external microcontroller and it provides an echo pulse as output. Your controller only has to measure the length of the echo pulse to find the range.



## Block Diagram



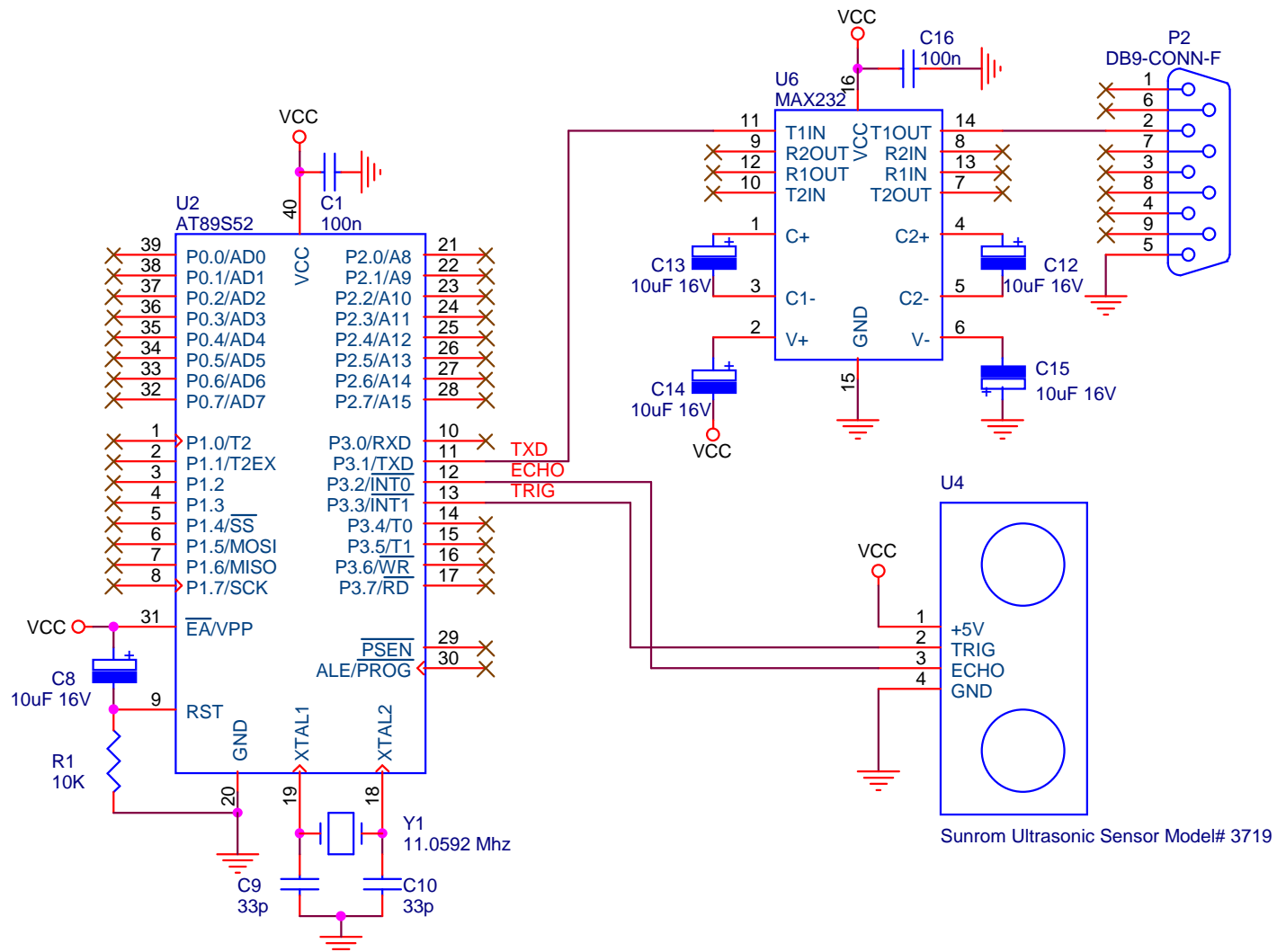
## How it works

You only need to supply a short 10uS pulse to the trigger input to start the ranging. The sensor will send out an 8 cycle burst of ultrasound at 40khz and raise its echo line high. It then listens for an echo, and as soon as it detects one it lowers the echo line again. The echo line is therefore a pulse whose width is proportional to the distance to the object. By timing the pulse it is possible to calculate the range in inches/centimeters or anything else. If nothing is detected then the sensor will lower its echo line anyway after about 200mS.

## Demo Application AT89S52

In this sample application, we will use popular microcontroller AT89S52 to measure distance. Then we will send this distance to PC via RS232 Serial Port and view it on Terminal software.

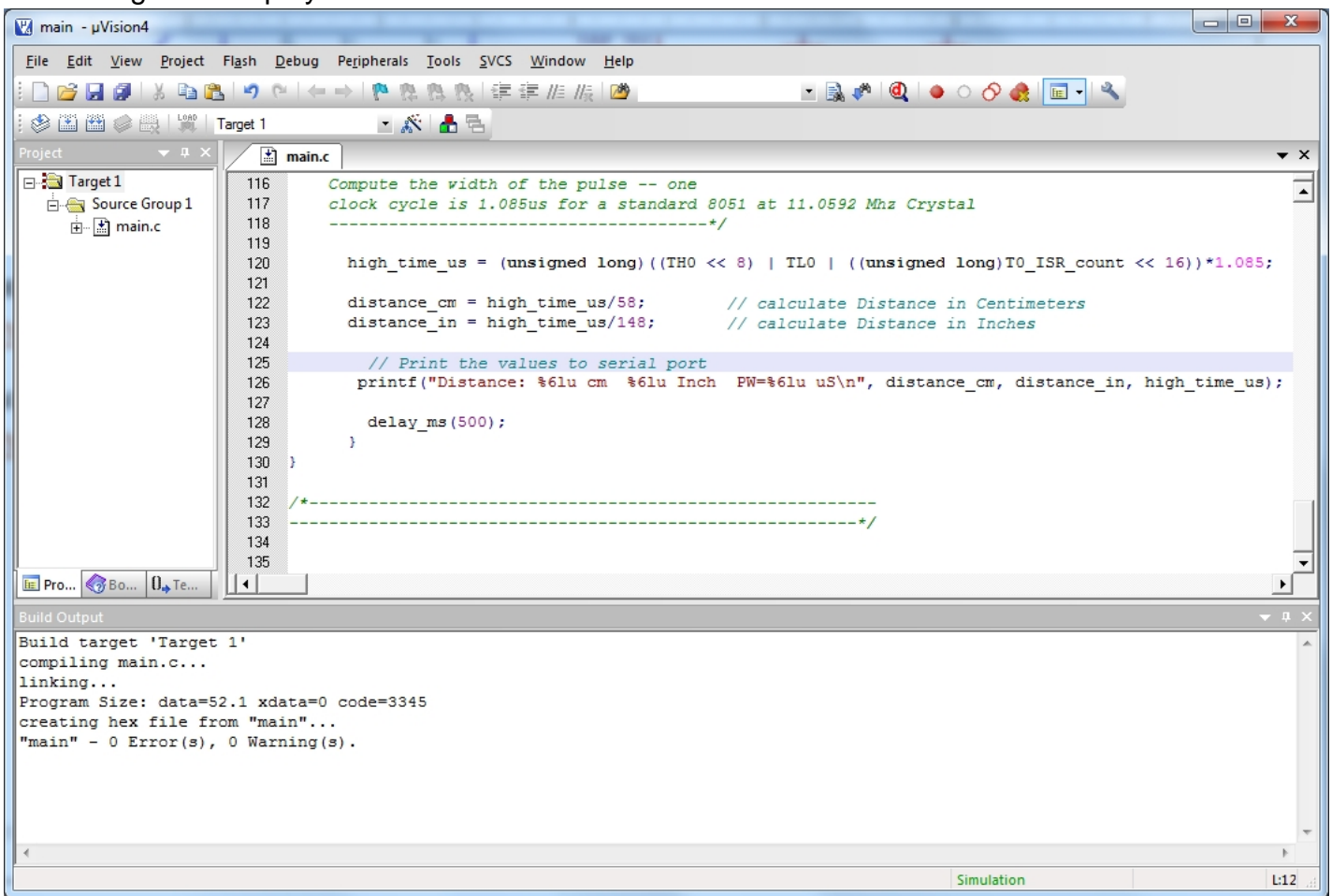
RS232 TO PC



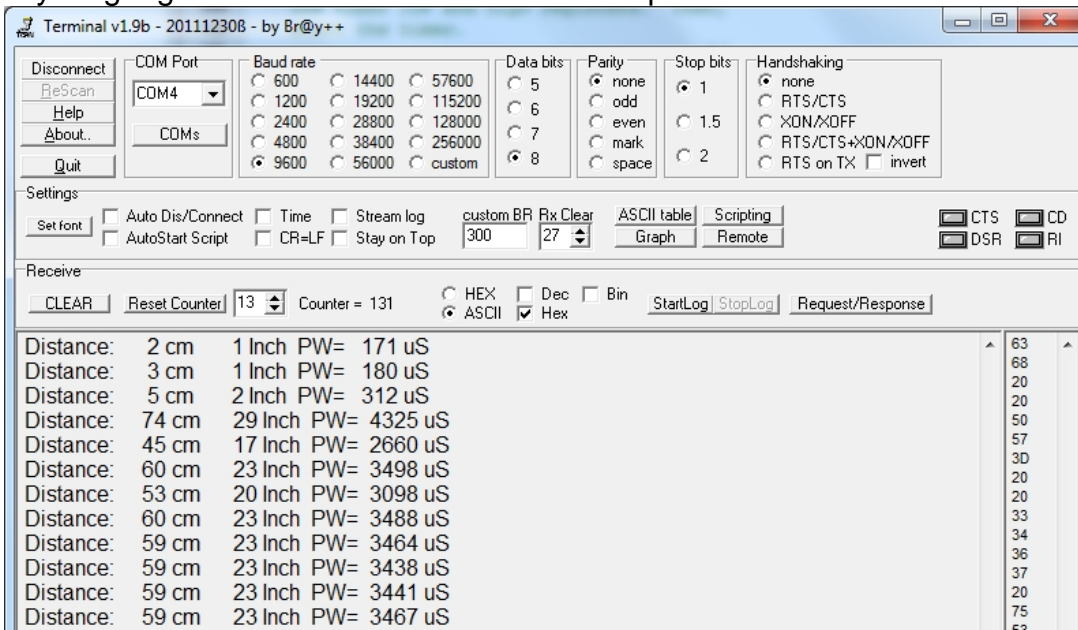
Full Source code+HEX file for this application in “C51 Keil Compiler” can be downloaded from here <http://www.sunrom.com/files/3719.zip>

Terminal software to view data on PC can be downloaded from here  
<http://www.sunrom.com/files/Terminal.exe>

Screenshot of software source code when open in Keil v9 C51 Compiler  
 Instead of printing to serial port you can create an application that can display values on LCD or Seven Segment Display

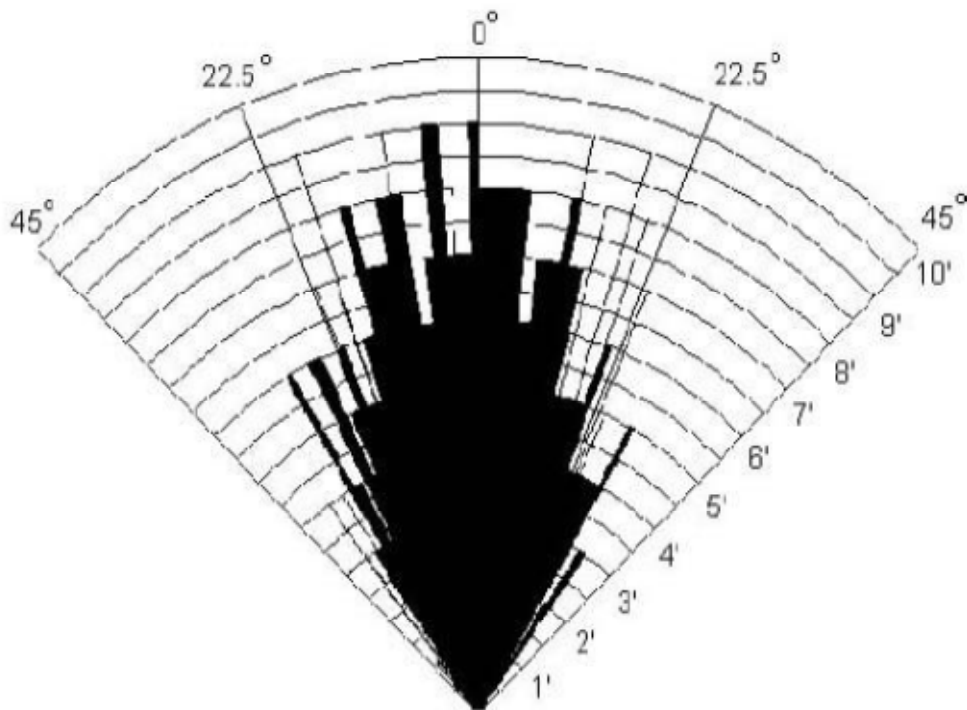


PC view of Terminal software is shown below. You can also develop a custom software in VB or any language too which can connect to serial port and read this data.





## Effective Angle of Measurement



*Practical test of performance,  
Best in 30 degree angle*

## Dimensions

